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| 10/616,268 | 07/09/2003 | Marvin Lo | CS02-073 | 1713 |
| 7590 07/26/2005 | | | EXAMINER | |
| STEPHEN B. ACKERMAN | | | PERALTA, GINETTE | |
| 28 DAVIS AVENUE | | | ART UNIT | |
| POUGHKEEPSIE, NY 12603 | | | PAPER NUMBER | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|-----------------------------------|--|
| Office Action Summary | Application No. 10/616,268 | Applicant(s) LO, MARVIN | |
| | Examiner Ginette Peralta | Art Unit 2814 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 May 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-45 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-4, 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kao et al. in view of Wu et al. (U. S. Pat. 6,780,761 B1).

Kao et al. discloses a method of forming a solder bump that comprises the steps of providing a structure; forming a metal bond pad 32 on the structure (col. 3, lines 34-36, 57-58); forming a patterned cover layer 33/35 over the structure, the patterned covered layer 33/35 including an opening exposing a portion of the metal bond pad 32, the patterned cover layer opening including side walls (col. 3, line 59- col. 4, line 3); forming a metal cap layer 38 over at least the exposed portion of the metal bond pad 32 and the patterned cover layer side walls (col. 4, lines 5-12); and forming a solder bump 21 over the metal cap layer 38 (col. 4, lines 14-15).

Kao et al. discloses the claimed invention with the exception of disclosing the patterned cover layer comprising a polyimide/benzocyclobutene stack.

Wu et al. discloses a method of forming a metallization in a semiconductor device that comprises forming a patterned cover layer 721/722/723 over the structure,

the patterned cover layer including an opening exposing a portion of the underlying structure, the patterned cover layer including sidewalls and being comprises of a polyimide/benzocyclobutene stack as disclosed in col. 3, line 51 to col. 4, line 7, wherein the patterned cover layer comprising a polyimide/benzocyclobutene stack is taught for the disclosed intended purpose of providing a metallization process that alleviates or eliminates photoresist residue in the metallization region, thereby improving the performance of the device.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a patterned cover layer including a stack of polyimide and benzocyclobutene not only because Kao et al. discloses the use of both materials to form its patterned cover layer 35, but also because Wu et al. discloses the use of a polyimide/benzocyclobutene stack for the disclosed intended purpose of providing a metallization process that alleviates or eliminates photoresist residue in the metallization region, thereby improving the performance of the device.

Kao et al. further discloses that the structure is a semiconductor wafer in col. 3, lines 32-33; that the structure is comprised of silicon (col. 1, line 20-23); that the metal bond pad 32 and the metal cap layer 38 comprise the same metal (col. 3, lines 34-35, and col. 4, lines 7-8).

Kao et al. further discloses that the metal bond pad comprises one of aluminum or AlSi (col. 5, lines 2-4), that the patterned cover layer may comprise polyimide and that a stacked layer 39A comprising benzocyclobutene may be deposited over the

structure; that the metal cap layer comprises aluminum (col. 4, lines 8-9); and that the solder bump comprises a tin lead alloy (col. 4, lines 33-34).

With regards to the thickness of the metal bond pad, the patterned cover layer, and the metal cap layer, and the width of the opening Kao et al. discloses that the patterned cover layer has a thickness of about 4.6 microns, and the metal layer has a thickness of about 1.7 microns but does not disclose the claimed ranges, but it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the ranges when forming a solder bump, and a bump pad structure within a certain range that is commensurate with the current state of the art as there is no statement denoting the criticality of the thickness of these features.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

3. Claims 5, 7-11, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kao et al. in view of Wu et al. as applied to claims 1-4, 6-10 above, and further in view of Cheung et al. (EP 1148548 A2).

Kao et al., as modified by Wu et al. above, further discloses that the metal bond pad comprises one of aluminum or AlSi (col. 5, lines 2-4), that the patterned cover layer may comprise polyimide and that a stacked layer 39A comprising benzocyclobutene may be deposited over the structure; that the metal cap layer comprises aluminum (col.

4, lines 8-9); and that the solder bump comprises a tin lead alloy (col. 4, lines 33-34), but does not disclose the use of a tin silver copper alloy for the solder bump.

Cheung et al. discloses a method of forming a solder bump that includes providing a structure; forming a metal bond pad 10 that comprises aluminum; forming a patterned cover layer 12; forming a metal cap layer 18 by sputtering; forming a solder bump 21 that comprises a tin silver copper alloy; and reflowing the solder bump to form a rounded solder bump, wherein an alloy comprising tin, silver and copper is taught for the disclosed intended purpose of using the tin silver copper alloy in lieu of a lead-containing alloy in order to produce a more environmentally conscious product that is compatible with the current processes.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a tin silver copper alloy instead of the tin lead alloy of Kao et al. for the explicit purpose of Cheung et al. of using the alloy in lieu of the tin lead alloy in order to produce a more environmentally conscious product that is compatible with the current processes that has improved characteristics and to form the metal layer by sputtering as it would have been within the scope of one of ordinary skill in the art.

4. Claims 12-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kao et al. in view of Wu et al. as applied to claims 1-4, 6-10 above, and further in view of Dagenais et al. (U. S. Pat. 6,506,672 B1).

Kao et al. discloses the claimed invention with the exception of subjecting the metal cap layer to a double zincation process.

Dagenais et al. discloses a method of improving an aluminum surface to make it solder wettable that includes subjecting an aluminum cap layer to a double zincation process; wherein the process comprises as shown in Fig. 3, forming a double zincation activated surface on the metal layer; an electroless nickel layer on the double zincation activated surface; and an immersion gold layer on the electroless nickel layer.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the metal cap layer of Kao et al. that comprises aluminum to a double zincation process for the disclosed intended purpose of Dagenais et al. of improving the aluminum surface by making it solder-wettable thus improving the adhesion of the solder bump to the structure.

With regards to the thickness of the electroless nickel layer, Kao et al. as modified by Dagenais et al. discloses an electroless nickel layer of 3.0 μ m, and an immersion gold layer of 0.2 μ m, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the ranges when forming a solder bump, and a bump pad structure within a certain range that is commensurate with the current state of the art as there is no statement denoting the criticality of the thickness of these features..

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16

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USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

5. Claims 17-20, 22-26, 28-30, 32-35, 37-41, and 44-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kao et al. in view of Wu et al. and Dagenais et al..

Kao et al. discloses a method of forming a solder bump that comprises the steps of providing a structure; forming a metal bond pad 32 on the structure (col. 3, lines 34-36, 57-58); forming a patterned cover layer 33/35 over the structure, the patterned covered layer 33/35 including an opening exposing a portion of the metal bond pad 32, the patterned cover layer opening including side walls (col. 3, line 59- col. 4, line 3); forming a metal cap layer 38 over at least the exposed portion of the metal bond pad 32 and the patterned cover layer side walls (col. 4, lines 5-12); and forming a solder bump 21 over the metal cap layer 38 (col. 4, lines 14-15).

Kao et al. discloses the claimed invention with the exception of subjecting the metal cap layer to a double zincation process and the patterned cover layer comprising a polyimide/benzocyclobutene stack.

Dagenais et al. discloses a method of improving an aluminum surface to make it solder wettable that includes subjecting an aluminum cap layer to a double zincation process; wherein the process comprises as shown in Fig. 3, forming a double zincation activated surface on the metal layer; an electroless nickel layer on the double zincation activated surface; and an immersion gold layer on the electroless nickel layer.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the metal cap layer of Kao et al. that comprises aluminum to a double zincation process for the disclosed intended purpose of Dagenais et al. of improving the aluminum surface by making it solder-wettable thus improving the adhesion of the solder bump to the structure.

Wu et al. discloses a method of forming a metallization in a semiconductor device that comprises forming a patterned cover layer 721/722/723 over the structure, the patterned cover layer including an opening exposing a portion of the underlying structure, the patterned cover layer including sidewalls and being comprises of a polyimide/benzocyclobutene stack as disclosed in col. 3, line 51 to col. 4, line 7, wherein the patterned cover layer comprising a polyimide/benzocyclobutene stack is taught for the disclosed intended purpose of providing a metallization process that alleviates or eliminates photoresist residue in the metallization region, thereby improving the performance of the device.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a patterned cover layer including a stack of polyimide and benzocyclobutene not only because Kao et al. discloses the use of both materials to form its patterned cover layer 35, but also because Wu et al. discloses the use of a polyimide/benzocyclobutene stack for the disclosed intended purpose of providing a metallization process that alleviates or eliminates photoresist residue in the metallization region, thereby improving the performance of the device.

Kao et al. further discloses that the structure is a semiconductor wafer in col. 3, lines 32-33; that the structure is comprised of silicon (col. 1, line 20-23); that the metal bond pad 32 and the metal cap layer 38 comprise the same metal (col. 3, lines 34-35, and col. 4, lines 7-8).

Kao et al. further discloses that the metal bond pad comprises one of aluminum or AlSi (col. 5, lines 2-4), that the patterned cover layer may comprise polyimide and that a stacked layer 39A comprising benzocyclobutene may be deposited over the structure; that the metal cap layer comprises aluminum (col. 4, lines 8-9); and that the solder bump comprises a tin lead alloy (col. 4, lines 33-34).

With regards to the thickness of the metal bond pad, the patterned cover layer, and the metal cap layer, and the width of the opening Kao et al. discloses that the patterned cover layer has a thickness of about 4.6 microns, and the metal layer has a thickness of about 1.7 microns but does not disclose the claimed ranges, but it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the ranges when forming a solder bump, and a bump pad structure within a certain range that is commensurate with the current state of the art as there is no statement denoting the criticality of the thickness of these features.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

With regards to the thickness of the electroless nickel layer, Kao et al. as modified by Dagenais et al. discloses an electroless nickel layer of 3.0 μ m, and an immersion gold layer of 0.2 μ m, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the ranges when forming a solder bump, and a bump pad structure within a certain range that is commensurate with the current state of the art as there is no statement denoting the criticality of the thickness of these features..

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

6. Claims 21, 27, 31, 36, 42, 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kao et al. in view of Wu et al. and Dagenais et al. as applied to claims 17-20, 22-26, 28-30, 32-35, 37-41, and 44-45 above, and further in view of Cheung et al..

Kao et al., as modified by Wu et al. and Dagenais et al., further discloses that the metal bond pad comprises one of aluminum or AlSi (col. 5, lines 2-4), that the patterned cover layer comprises a polyimide/benzocyclobutene stack; that the metal cap layer comprises aluminum (col. 4, lines 8-9); and that the solder bump comprises a tin lead alloy (col. 4, lines 33-34), but does not disclose the use of a tin silver copper alloy for the solder bump.

Cheung et al. discloses a method of forming a solder bump that includes providing a structure; forming a metal bond pad 10 that comprises aluminum; forming a patterned cover layer 12; forming a metal cap layer 18 by sputtering; forming a solder bump 21 that comprises a tin silver copper alloy; and reflowing the solder bump to form a rounded solder bump, wherein an alloy comprising tin, silver and copper is taught for the disclosed intended purpose of using the tin silver copper alloy in lieu of a lead-containing alloy in order to produce a more environmentally conscious product that is compatible with the current processes.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a tin silver copper alloy instead of the tin lead alloy of Kao et al. for the explicit purpose of Cheung et al. of using the alloy in lieu of the tin lead alloy in order to produce a more environmentally conscious product that is compatible with the current processes that has improved characteristics.

Response to Arguments

7. Applicant's arguments with respect to claims 1-45 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (571) 272-1713. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GP

Wael Fahmy
SPC 2814